Newsbulletin
50 Los Alamos National Laboratory

Student scientists shake up rugged Rio Grande Valley

For about a week in July the rugged desert area southeast of Velarde shook subtly underfoot ... but not because of earthquakes.

It was college students — and scientists — who were responsible for the seismic activity.

For the 12th year in a row, students from all points on the compass joined Los Alamos geophysicists and university researchers in an intense, three-week study of the Rio Grande Valley, as part of SAGE: Summer of Applied Geophysical Research.

The 31 students taking part in SAGE this summer immersed themselves in the hows and whys of geophysics — in the relentless heat and harsh terrain of the high desert when they set up their instruments, and in the air-conditioned comfort of the classroom when they discussed results and learned geophysical principles.

"For a person in college, who may be considering a career in geophysics, a program like SAGE is a great opportunity; and we know of no other program that is like SAGE in scope or intensity," said Scott Baldridge, SAGE co-director and a Laboratory geophysicist in Geology and Geochemistry (EES-1).

SAGE is sponsored by the Laboratory's Institute of Geophysics and Planetary Physics, and receives support from the Department of Energy, National Science Foundation, and a range of large corporations and small companies. Since its inception more than a decade ago, SAGE has held true to its goal of developing a unique geoscience educational program that would provide its students with a true, hands-on, research-scale geophysical experience.

The experience, Baldridge said, is something most students would never get until they actually began working in the field as geophysicists in a full-time job.

No more than two students from any single university will be accepted into the program each year. Baldridge said the policy gives the program a lot of diversity. This year, students from Ireland, Sweden, Canada and Mexico joined the ranks.

Research is not the primary objective. Instead, Baldridge said, the initial motivation is teaching geophysical techniques. However, since data about the Rio Grande Rift system are collected each year by SAGE, some results will be published. In fact, Baldridge said, the Bulletin of the Geological Society of America will publish a report later this year that is based on data gathered during the 1990-1991 SAGE program.

Students and researchers are looking at the Rio Grande Rift, which stretches from southern Colorado to Mexico, in part because it's one of three active rift systems in the world. SAGE program participants are collecting data that will help determine the basic geometry of the rift and how the system has developed since it began stretching, sagging and slipping under the strain of tectonic forces nearly 30 million years ago — practically the day before yesterday, geologically speaking.

Techniques to measure geologic features are as diverse as the students in the group: Seismic reflection and refraction, gravity measurements, magnetotelluric surveys and shallow electromagnetic surveys are among techniques integrated by students in their attempt to learn the secrets of the rift. Time in the classroom before and after field work gives students insight into what they will do and what they have done out in the field.

But class time would be meaningless without a journey into the field ...

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Student scientists shake up rugged Rio Grande ...

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The SAGE field experience

The blue tent tentatively planted on the rocky, parched earth southeast of Velarde provides its occupant with little relief from the nearly 100-degree temperatures and from the sun, which bites savagely at unprotected flesh.

But George Jiracek, San Diego State University professor, who is showing students how to use magnetotellurics, has hunkered down in the colorful nylon dome peering at computer screens. The data from the field already have caught his eye.

Magnetotellurics looks at how charged particles from the sun interact with Earth's magnetic field, giving geophysicists a way of looking at the deep crust and upper mantle of the Earth.

"This data tells us that about 16,000 meters below the surface there is a conductive zone of some kind," Jiracek says, excitement dripping off him like the sweat from his neck. "It's probably a water layer, and I think this layer is really key to why the rift formed like it did."

Jiracek points out that of all the field experiments going on in the area, magnetotellurics is the only one so far that has detected the conductive layer.

Outside the control center, students slathered with sunscreen are scurrying around like deer mice, setting up equipment, talking to corporate representatives from Zephyr Engineering, which provided equipment for the magnetotellurics part of the program, and occasionally peeking their heads into the tent to see if the data have changed.

About a mile away, students are learning seismic reflection and refraction. Two gigantic trucks with huge metal pads underneath inch their way along, stopping frequently. At each stop the pads are lowered until they come in direct contact with the earth. Then, the pads begin to vibrate, sweeping through a range of frequencies. The process is repeated again and again.

The trucks, in effect, make tiny earthquakes that reflect off subsurface features and are detected at various points along a line of receiver instruments. The instruments are so sensitive that they can detect someone walking nearby, so students freeze in place when they feel the vibrations — which start in the bottom of the person's feet, making their way up the legs, along the spine and into the skull, which buzzes for about 10 seconds.

For SAGE student Doug Newcomb, from the University of California, San Diego, the big Vibroseis trucks were a new experience.

"We've done this at school on a small scale with a metal plate and a sledge hammer, but never anything like this," Newcomb said.

Student Eric Phinney, from Virginia Polytechnic Institute, said the Vibroseis trucks definitely were a new experience.

"In class work I've seen data like what we're getting, and I've used it for some problems, but I had no idea how it was generated," he said. "This has just been great."

However, the program goes beyond the books. It seems to create a sense of community for the students involved. While in the field and in the classroom, students interact closely with one another.

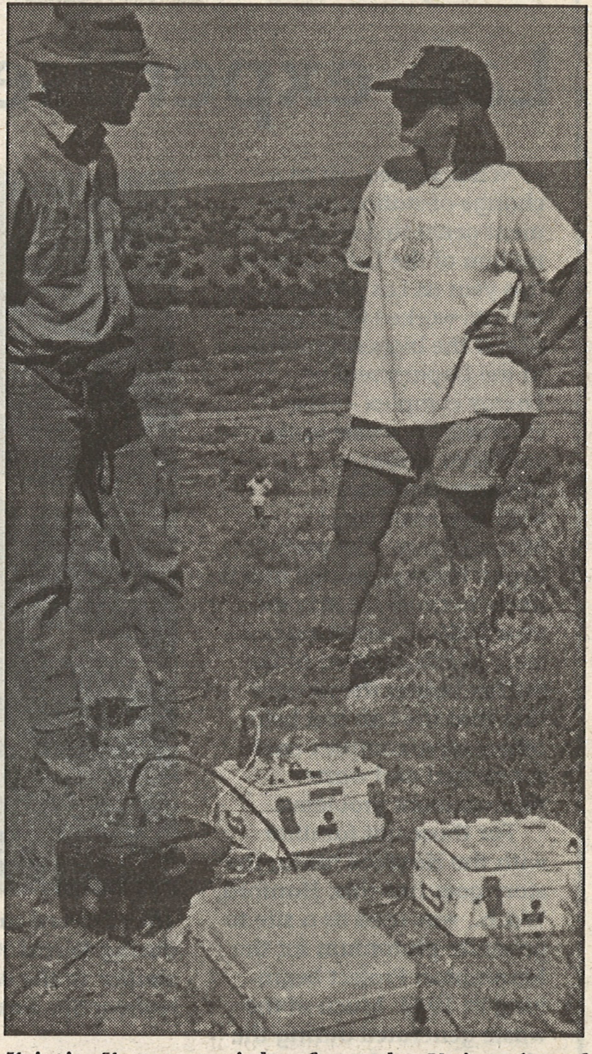
Marie Murphy, from Dublin University, said the program was "an adventure." Murphy, who was in the United States for the first time, said she made lasting friendships in the program.

"I plan to keep in touch with some of the people who I've made friends with during the summer," she said. "This has been just great."

Back at the tent, Jiracek, SAGE program co-director, peers out of the tent at the busy students. He reflects for a moment on the program's dedication to the student.

"You know, there are students who show up here at SAGE who have never even heard of magnetotellurics," he says. "Three weeks later they get up and do a 15-minute talk on it that's of professional quality, and that's just outstanding, I think. There is very little opportunity for them to be exposed to these types things and to have a chance to really learn them."

Jiracek gives his students a Hawaiian phrase at the beginning of SAGE that sums up his



Kristin Kummer, right, from the University of California, Santa Barbara, discusses how to use transient electromagnetics with Scott MacInnes, from Zonge Engineering, a SAGE corporate sponsor. *Photo by James Rickman*

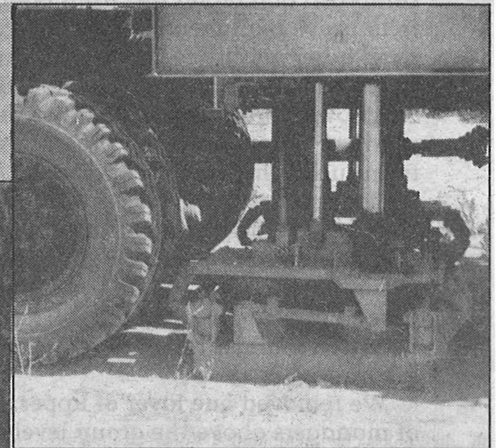
philosophy of how they should approach the program.

"A' a' i' ka hula," he tells them.

Dare to dance.

—James Rickman

Below, Eric Phinney of Virginia Polytechnic Institute makes his way around one of the big Vibroseis trucks as is makes its way through the desert terrain southeast of Velarde during the Summer of Applied Geophysical Research field work.



Inset above, the large plate on the bottom of the Vibroseis truck, in contact with the ground, delivers the vibrations that will provide clues about subsurface features of the area.
Photos by James Rickman